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PARASITES IN WAR TIME

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PARASITES, always of major importance in tropical countries and of considerable importance in the temperate zones, take on increased importance with the onset of war. In a general way this is due to two factors. In the field of human medicine it is due to the fact that the sanitary and hygienic provisions of armies in the field can not maintain the high level attained in peace times among civilian and soldier elements of the population, while the throwing together of persons of the most diverse habits of cleanliness and regard for personal condition, under such unfavorable circumstances, affords a chance for the spread of such parasitic pests as would under ordinary conditions be confined to those who were habitually careless or unmindful of these pests, or who were exposed to them by virtue of geographical or environmental conditions. In the field of veterinary medicine, the increased importance of parasites is due, not only to the spread of parasitic diseases among horses purchased all over the country and brought together on the picket line, but also to the fact that present-day war conditions call for the conservation of all resources, especially food and factors in food production, and for the elimination of losses from parasites which in peace times may be ignored as matters concerning only the individual who sustains the loss, but which in war times must be regarded as subtractions from a relatively limited and highly necessary sum total of the common possessions of the nation, the loss of which ranks with losses in battle as factors in defeating our armies and the ends for which they fight.

In the field of human medicine, there are two problems: The immediate problem is the control of parasitic diseases and the diseases, bacterial or otherwise, associated with the parasites; the remote problem will concern itself with preventing the importation into this or other countries heretofore free from them, of the various exotic diseases with which soldiers may be brought in contact by association with troops brought from tropical and semi-tropical regions where these diseases are prevalent.

Among the parasites of man that deserve mention, lice should be regarded as of first importance. Wherever men are thrown in close physical contact in the trenches and dug-outs and in crowded billets in the wrecked structures still standing in the vicinity of the contested areas in France, there is ample opportunity for the spread and multiplication of these annoying and dangerous parasites. Leiper has referred to these pests as the "minor horrors of war," and they are not peculiar to present-day trench warfare. The world's wars have regularly been fought by lice-infested soldiers. In our Civil War lice were familiarly known among the soldiers as "graybacks" and anecdotes of that conflict commonly deal with these ubiquitous insects. It is said that General Mott once stopped in a walk through a camp to observe with interest the close investigations that Private Lindaberry was conducting along the seams of his shirt. "Are you picking them out?" he asked. "No, sir," was the reply, "I'm taking them as they come." It might be noted in passing that this method of hand-picking, elsewhere applied to the eradication of the cattle-tick and the boll-weevil, is still used as a practical means of control for lice in the present war—a palliative, if not entirely remedial, measure. As an illustration of the utility of applied entomology in this connection may be noted the practise of placing lousy garments on ant hills, which is said to result in the careful removal of the lice by the ants. This is not a particularly valuable or widely applicable method, of course, but the purely entomological aspects of louse control are so important that Vaughan has recommended that entomologists versed in medical entomology be attached to our army units.

Louse control, however, calls for a knowledge of more than entomology. It presents large problems in therapeutics, the therapeutic agents employed being primarily insecticides within the field of medical rather than entomological science. Over two hundred insecticides (and substances suspected, often on very little evidence, of being insecticides) have been tested since the outbreak of war, and the large literature dealing with this topic which has appeared since 1914 is still in poorly digested condition, with varying and often conflicting claims for the same insecticides. However, experience has established beyond question the value of kerosene and gasoline in controlling lice, as these substances kill both the lice and the eggs, or "nits," very quickly. In some instances, companies of men have been stripped and thoroughly sprayed with these substances, with excellent results in controlling the trouble and

with but little personal discomfort on the part of the men. As regards ointments for individual use, ordinary petrolatum (vaseline, cosmoline, etc.) has been found quite effective and is rated by Castellani with kerosene or gasoline as among the most effective insecticides. For the most part, however, the clothes louse, or body louse, the most important of the lice attacking man, lives in the clothing, especially in the seams, and must be killed here. For this purpose dry heat affords a very satisfactory control measure, an adequate heat resulting in the coagulation and desiccation of the protoplasm of the louse and its egg. In addition to sprays, applications and heat, there is quite a range of supposedly valuable remedial and preventive measures, including sachets of various designs and contents, muslin underwear impregnated with sulphur and naphthaline, body cords smeared with mercurial ointment and worn about the waist, ordinary soap-and-water cleanliness—and even chiropractic measures have been advocated. It appears that the correct chiropractic procedure, according to the publication cited, involves an adjustment of the first lumbar vertebra, but offhand it would appear better to confine manual manipulation to hand-picking or else apply the pressure to the lumbar region of the louse rather than to that of the patient.

The importance of lice is due less to their own irritating activities as blood-suckers than to the fact that they carry the dreaded typhus fever germs; the prevention of typhus is lice control. This is a menace to which our army is now and will be exposed. It is impossible to raise large armies without including louse-infested individuals, and Vaughan notes that we had such individuals in our army on the Texas border, though there was no exposure to typhus. But since lice are a menace and freedom from lice a defense in the presence of typhus, our medical corps will need to devote considerable attention to delousing measures for the protection of our troops.

Another parasite which attacks from the outside is the itch mite, the cause of itch, or scabies. This little relative of the spiders burrows in the skin, causing an itching sensation, and the fingers of the victim, in an effort to relieve the itching, complete the job of producing sores and scabs. An interesting bit of news from the front in this connection is to the effect that soldiers suffering from this distressing complaint have been cured by exposure to chlorine gas during gas attacks by the Germans. Subsequently the proposal has been made to clear out certain insect pests in valley lands by the use of heavy poison gases as an agricultural measure.

The numerous biting flies and mosquitoes frequently find exceptionally favorable opportunities for breeding in war areas where remedial measures, such as oiling bodies of water or draining them to prevent mosquito breeding, can not be applied to the contested No-Man's Land. Trench-helmets are no protection from these flying projectiles, though a gas-mask might be! Perhaps even more favorable are the opportunities for the breeding of the numerous non-biting flies which live as maggots in dead bodies of horses, other stock and of men. Many of these maggots readily adapt themselves to life in wounds and in the summer or in the more tropical war zones, infestation of wounded and sick men with these maggots becomes a rather common and often serious complication. It is rather surprising to find, however, a statement from a medical officer in the war zone to the effect that gas gangrene, one of the most serious conditions encountered in this war, rarely appears in wounds infested with maggots.

Among the worm parasites, hookworms deserve especial consideration in this country, since a large part of our army comes from the hookworm-infested sections of the South. Stiles has already called attention to the occurrence of hookworm disease found among our soldiers from the South and urged the desirability of detecting such cases and using the appropriate anthelmintic treatment to rid these men of their parasites. The importance of this action is fairly evident. Hookworm disease results in anemia, lassitude and inertia, and the task of overthrowing Prussian militarism and the armed application of Pan-Germanic philosophy can not properly be regarded as a task for anemic and inert troops. The examination of soldiers for hookworm disease would incidentally disclose other parasitic infestations. Hookworm disease is contracted commonly by the invasion of the skin by the larvæ, which develop from hookworm eggs in the excreta of hookworm subjects, and trench conditions afford uncommonly favorable conditions for the spread of this disease. It is true that adequate measures are taken for the disposal of excreta under most of the working conditions of the present war, but there are many extraordinary conditions under which these measures can not be taken, and in spite of the care and authority of medical officers there are always men who neglect or ignore the provisions made for the common safety and welfare. And it is precisely the men accustomed to the lack of sanitary provisions in infected rural communities who might most easily fail to appreciate the value of these provisions under the stress of war conditions. An-

other aspect of the matter is this: This continent is practically free from the Old World hookworm, *Ancylostoma*, but so is Europe practically free from our Afro-American hookworm, *Necator*; while we would not be grateful for an importation of *Ancylostoma* in returning troops, neither would our allies approve a dissemination of *Necator* by our soldiers abroad.

Among the worm parasites, *Strongyloides*, a worm associated with a diarrhea, has a peculiar interest. This parasite also occurs in this country and Stiles has recently recommended that soldiers so infested be discharged, for the reason that no satisfactory treatment for this condition is known. In view of the lack of a known dependable treatment and the disability due to the disease, this is good advice—but may we now expect our slackers to seek an infestation with *Strongyloides* to escape army service?

The same difficulties in sanitation that make the acquirement of hookworm infestation easy make it easy to acquire *Strongyloides* or the other common intestinal parasites, such as ascarids, whipworms and pinworms. It may also be found that infestation with the dwarf tapeworm, *Hymenolepis nana*, the commonest tapeworm parasite of man in this country, will spread in the war zone. Reports state that the trenches swarm with rats, and as this tapeworm appears to be normally a parasite of rats, occurring in man as a result of the contamination of food-stuffs by these enemies of mankind, it is conceivable that this worm will need attention.

Rats, however, have an importance in connection with disease which exceeds their importance as carriers of the dwarf tapeworm. They are the reservoirs of the dreaded bubonic plague and the rat fleas commonly present on them are the habitual transmitters of the disease from rat to rat and from rat to man. Should plague-infested rats appear among those in the trenches, practically any measures for combating the rats would be justified and the campaign against the Central Powers would have to be subordinated to a rat-killing campaign in which the use of poison gases would probably be a weapon of major importance in destroying rats and fleas alike.

The conditions of present-day warfare also afford opportunity for the spread of disease, characterized in part by diarrhea, due to amebic and flagellate protozoa. These minute organisms may be spread rather directly from the excreta or carried from the excreta by flies. These diseases are already present on some fronts and are receiving a considerable amount of investigation along the lines of preventive measures and treatment.

The more remote activities of our medical corps in preventing the importation of exotic diseases of a parasitic nature may only receive brief mention here. Such diseases as coccidiosis, a protozoan disease, occurring in the Balkans and elsewhere, are not known to occur in man on this continent, nor is bilharziasis, a disease occurring, among other places, in Egypt. In the latter disease, worms may occur in the blood vessels of the lower bowel or of the urinary bladder, causing an inflammation and hemorrhage of these organs as a result of the passage of their eggs through the tissues. The list of parasites of man not known to occur in this country and known to occur in some of the widely distributed war areas is a long one, but it is unnecessary to enumerate. Our medical corps can be depended on to take the necessary measures to prevent our troops from becoming infested and to provide proper treatment or adequate quarantine for those who by carelessness or inadvertence become infected.

In this connection it might be noted that war conditions call for new investigations in the field of anthelmintic treatments for worms. Along with the cessation of importation of other drugs due to the war, the supply of thymol, the drug commonly in use in this country before this war for the treatment of hookworm disease, was shut off, with the result that a superior remedy, of American origin, oil of chenopodium, has come into general use. The plant from which this remedy is obtained is one that was used by the Indians before Columbus discovered America and has been used as a home remedy and by the Southern "mammies" for many years, but it required a war, with its stoppage of commerce, to bring about a high degree of interest in this American product.

In the field of veterinary medicine, as has been noted, there is ample opportunity for work in controlling parasitic diseases among horses in the army and in preventing enormous losses to our live-stock industry by eradicating parasites. Of major importance are such diseases as Texas fever of Southern cattle, a disease caused by a protozoan parasite in the blood and carried by an external parasite, the cattle tick; scabies in cattle, sheep and horses, due to mites closely related to those causing itch or scabies in man; stomach-worm disease of sheep, due to a blood-sucking worm; and "worms" in pigs. Other parasites which do much to swell the grand total of losses are the various lice, true ticks and so-called ticks, and other biters and blood-suckers which live on our stock, and the lungworms, hookworms, palisade worms, tapeworms and flukes which live in them.

The increasingly successful campaign against the cattle tick which carries Texas fever is an epic in the warfare of veterinary medicine against disease. It is a warfare in which the names of great leaders, executives and laboratory men stand out conspicuously, men from the U. S. Bureau of Animal Industry and from the experiment stations of the Southern states. In a warfare as real and as systematic as the conflict of militarism and democracy, the tick has been attacked from a quarantine line that once extended rather directly across the United States from Virginia to California and from this far-flung battle-line the tick has been driven toward the Gulf of Mexico from county to county and state to state. Wedges have been driven into the line and the tick forces have been split by drives down the Mississippi River states. Recently, December 1st, the entire state of Mississippi was released from quarantine and the governor designated the day of release as a day of rejoicing to celebrate the event. In the general order releasing this state a total of over 65,000 square miles was released. At first the campaign against the tick was a scientific problem, the study of the foe's weaknesses, habits and life history and the development of offensive and defensive weapons. This problem was presently solved; suitable dips to be readily applied by swimming the cattle through a dipping vat furnished the weapons with which to begin an offensive. The quarantine line blockaded the enemy and kept the tick from fresh supplies of food among the Northern cattle. The problem then became one in diplomacy. At favorable points the tick was able to make a stand with the aid of strong allies, uninformed, misinformed or hostile individual stockmen who objected to dipping, who met the inspectors with a club or a shotgun. It is a striking feature of this phase of the tick-eradication campaign that men trained only as veterinarians should have acquitted themselves so admirably in such delicate and dangerous situations. With a minimum amount of actual clash and combat, this opposition was overcome by argument, persuasion and friendly discussion. There is little of this opposition remaining, the task is more than half completed, and the work yet undone is hastening to a conclusion. The time is fast approaching when through the cooperation of the federal and state authorities the last tick will be dipped or collected as a museum specimen, or whatever is appropriate for a last tick, and the tick and Texas fever will become extinct in this country. Already the slogan is "A tick-free South in 1921." When that time comes, the South, with its abundance of feed, rich soil,

abundant rainfall and long-growing periods for crops, will take over a large part of the live-stock industry of this country. Were the tick eradicated right now, in this fourth year of the great war, it would immensely strengthen the hands of this country in coping with the problem of meat supply during that war. The annual losses attributed to the presence of the tick are estimated at \$50,000,000, a loss of meat and leather that is especially hard to contemplate at this time. The cattle tick is a very real enemy that deserves to rank in destructiveness, if not in wilful *Schrecklichkeit*, with the invaders of Belgium and the destroyers of the *Lusitania*.

While the campaign against the cattle tick has been pressed in the South, the drive against sheep and cattle scabies in the West has pushed on until the objectives have been almost attained. These diseases have cost this country dearly, and at one time sheep scab was the terror of the Western sheepman. At the present time the only terrain still held by the enemy is in California and Texas, where there is still some sheep scab. Cattle scabies has been practically exterminated over the one and a quarter million square miles first quarantined. The saving in wool, leather, mutton and beef, all unusually valuable in these days of war, constitutes an indemnity that repays us many times for the outlay which it has cost to prosecute this campaign.

Unfortunately, the report with regard to another enemy of our live-stock, the stomach worm of sheep, is not so cheerful. Sheep suffer little from bacterial diseases and are immune to tuberculosis, but they are attacked by numerous animal parasites and by an ally of the parasites, the sheep-killing dog. The ownerless cur and the uncontrolled sheep-killer stand with the stomach worm in opposition to the sheep and mankind and are at this time nullifying much of our efforts at conservation by their attacks upon the mutton and wool supply of this nation. There are medicinal treatments and preventive measures of great value in controlling stomach-worm disease, but these measures are not generally known and used to anything like the extent they should be. It would perhaps be well for the federal and state agricultural authorities to send well-informed men into communities where sheep were kept, to explain and demonstrate these methods. As for the sheep-killing dogs, they should be placed by law beyond protection and made the legitimate prey of any one who can find the time to shoot them or otherwise remove these parasites of the sheep industry.

The big ascarid worms of pigs are another constant source

of loss to our live-stock industry, and are especially severe in their effects on young animals, a general truth in regard to parasites. The U. S. Department of Agriculture has on a number of occasions urged the use of oil of chenopodium against these worms, and it is to be hoped that adequate measures of treatment will be used during the coming year, to aid in conserving our swine industry with its fat supply, which Germany found so suddenly and extremely valuable after her ill-advised slaughter of a large part of her swine to conserve food they might eat. There is at present a desire to control worm infestation in swine by the use of such procedures as feeding mineral mixtures of various sorts and various stock feeds. Such preparations may have value in furnishing mineral constituents to swine or in improving their appetites, but if they have anthelmintic value the writer is unaware of it and has not found it experimentally. Such preparations, if aimed at parasites, are ammunition wasted.

The numerous external parasites of stock can be, and decidedly should be, controlled by dipping, and there is no lack of suitable dips. Some of the internal parasites can be controlled by appropriate medication, whereas others need much more study, never more necessary than now.

Our newly reorganized Army Veterinary Corps will find ample occasion to recognize the importance of parasites in war times when they are compelled to cope with mange in cavalry, artillery and transport horses. At times certain stations in the French army have had as high as 60 per cent. of their horses disabled with this disease, and its control is not a simple matter. The presence of large numbers of lice on these horses will demand attention. Worm infestations in horses often occasion damage of a serious character, with the complication that these infestations are not readily recognized. That our veterinary corps will prove capable of coping with these conditions can not be doubted. The veterinary corps of the armies of the Allies and of the Central Powers have met the problems of modern warfare with the ready development of practical field measures, supplemented by research where necessary, and in the doing of this have been the recipients of numerous citations and decorations for conspicuous bravery under fire. The veterinary corps of the United States Army is calling into the service numerous veterinarians from private life to assist the small corps of veterinarians heretofore attached to our correspondingly small regular army, and in the development of practical and ingenious measures for meeting emergencies the American veterinarian will show himself second to none.

In attacking the problems of parasite control in war times, this country is fortunate in commanding the services of many able helminthologists, protozoologists and entomologists. There already are in the government service a number of these men, among whom might be mentioned Ashford and Craig in the army, Stitt in the navy, Stiles in the Public Health Service, Ransom in the Bureau of Animal Industry, Cobb in the Bureau of Plant Industry, and Howard, Hunter, Knab and Bishopp in the Bureau of Entomology and the Division of Insects of the U. S. National Museum. In addition there are many able and well-known men associated with these. Other men who may be drawn on are associated with such institutions as the Harvard School of Tropical Medicine, the Tulane School of Tropical Medicine, and the Rockefeller Foundation, while numerous other workers in these lines are scattered throughout the country. And we can count upon the assistance and co-operation of the numerous and able parasitologists of France and England in dealing with war-zone problems in parasitology.

No discussion of war-time parasites would be complete without mention of the profiteer that fattens on the body politic, the alien enemy that invades our institutions and destroys our substance, the slacker who, like the hookworm, is nourished by our organism but fails to function in its defense and support, but the treatment, remedial or surgical, for these parasites is not in the hands of our physicians and veterinarians; under the leadership of our able President, that affair is the affair of every loyal American.